SEASONAL FLIGHT PERIODICITIES OF SIX MICROCADDISFLIES (TRICHOPTERA: HYDROPTILIDAE, GLOSSOSOMATIDAE) IN THE BRAZOS RIVER, TEXAS, WITH NOTES ON LARVAL BIOLOGY AND SITE RECORDS[1]

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ABSTRACT: The seasonal flight periodicities of six small caddisflies were studied from April, 1995, to November, 1996, at a large riffle of the Brazos River in north-central Texas. Light trap samples for adults suggested a synchronized univoltine cycle for *Protoptila alexanderi*, asynchronous univoltine cycles for *Hydroptila icona* and *Orthotrichia cristata*, bivoltine cycles for *Ithytrichia clavata* and *Ochrotrichia tarsalis*, and a multivoltine cycle for *Hydroptila angusta*; the last species accounted for 82% of the total hydroptilid adult abundance. Larval collections of *P. alexanderi*, *H. angusta* and *I. clavata* confirmed their presence in the benthic community. Seven site records and one drainage record of *Neotrichia vibrans* were documented, increasing the total number of caddisfly species found at this site by Moulton et al. (1993) to 30.

The caddisfly family Hydroptilidae, often referred to as the "microcaddisflies", contains the smallest members of the Trichoptera, with adults of many of the 220 Nearctic species reaching only 2-3 mm in length (Wiggins 1996). Hydroptilidae is the most species rich trichopteran family, and often ten or more congeners can occur together at a single site (Moulton and Stewart 1996). Despite this, very little is known concerning hydroptilid life histories and behavior. Nielson (1948) studied the biology of five Danish species; elucidating univoltine cycles for *Orthotrichia tetensii* Kolbe and *Ithytrichia lamellaris* Eaton, and bivoltine cycles for *Agraylea multipunctata* Curtis, *Hydroptila femoralis* Eaton and *Oxeythira costalis* Curtis. This work remains the source for much of the knowledge of larval morphology, feeding, case-building behavior and general biology of the family (Marshall 1979, Wiggins 1996).

Other ecological studies of hydroptilids have dealt with the drift patterns of larvae, including those of *Hydroptila rono* Ross and *H. icona* Mosely, respectively, in an Oregon and Texas stream (Anderson 1967, Cloud and Stewart 1974a) from which an interpretation of univoltine life cycles was made by Wiggins (1996). Resh and Houp (1986) studied the biology of *Dibusa angata* Ross and found it to be bivoltine in a Kentucky stream and dependent on the red alga *Lemanea australis* Atkinson for food and case-building material. Marshall (1979) reviewed the world genera of Hydroptilidae.

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Moulton et al. (1993) documented 23 species of Trichoptera from a riffle of the Brazos River in Palo Pinto County, Texas as part of their investigation of the Brazos River caddisfly fauna. This documentation included 10 hydroptilid species and one member of the glossosomatid caddisfly subfamily Protoptilinae, *Culoptila cantha* (Ross). Protoptiline glossosomatids are often field-sorted in with hydroptilids due to their small size; no life history information has been reported for any of the 18 North American species (Wiggins 1996). The purpose of our study was to document the seasonal flight periodicities of microcaddisflies at this Brazos River site as suggestive of their respective voltinisms.

MATERIALS AND METHODS

Study site. The Brazos River arises on the Caprock Escarpment in eastern New Mexico and flows southeasterly through Texas to the Gulf of Mexico. Our study was conducted at a 200 m riffle located approximately 35 km downstream of the Morris Shepard Dam in Palo Pinto County; research on the biology of many aquatic insects has been ongoing at this site for 25 years (Stewart et al. 1973; Cloud and Stewart 1974a,b; Vaught and Stewart 1974; McClure and Stewart 1976; Rhame and Stewart 1976; Houghton 1997). Recent descriptions of this site can be found in Moulton et al. (1993) and Houghton (1997).

Adults. Adults were collected from April, 1995, to November, 1996, using two 8-watt portable ultra-violet lights placed over two 22.5 X 35 cm white porcelain pans filled with 70% ETOH. These samples were generally taken monthly from October to March and twice monthly from April to September. The pans were set about 1.0 m from the water's edge; one at the head of the riffle, and the other 16.5 m downstream. Preliminary observations had indicated predominately nocturnal flight periods for Brazos microcaddisflies; therefore lights were run for 20 minute intervals beginning at dusk, separated by 40 minutes between samples, until three sets of samples were taken or until a sample yielded no adults of any species. A small number of *Hydroptila angusta* Ross adults were aspirated from riparian rocks and vegetation prior to dusk during February and March, 1996. Each sample taken was sub-sampled by the following procedure: the specimens were placed in a 9.5 cm diameter round petrie dish and mixed thoroughly; a 3 cm diameter ring was randomly placed into the sample and all individuals within the ring area were counted; the number of males and females of each species found was extrapolated to estimate the total number present in each sample; the samples were combined to estimate the number present on each sampling date.

Larvae and Pupae. Larvae and pupae were collected off rocks with soft-touch forceps on the same sampling dates as adults and either preserved in 70% ETOH or transported alive back to the laboratory in Styrofoam "six-pack" coolers (Szczytko and Stewart 1979). Larvae and pupae were reared in wire

mesh baskets within a Frigid Units Living Stream™ with Brazos River simulated flow, temperature, photoperiod, and natural algal food to estimate pupation period and associate the life stages using the metamorphotype method (Milne 1938). Behavior of fifth instar larvae was observed by placing individuals in a 5 cm diameter petrie dish under a Wild M2E dissecting microscope equipped with a Dyonics fiberoptic light source. Voucher specimens of all species studied are deposited in the University of North Texas Entomological Collection.

RESULTS AND DISCUSSION

Seasonal flight periodicities were determined for the hydroptilid species *Hydroptila icona*, *H. angusta*, *Ithytrichia clavata* Eaton, *Ochrotrichia tarsalis* (Hagen) and *Orthotrichia cristata* Morton, and for *Protoptila alexanderi* Ross (Glossosomatidae: Protoptilinae) (Fig. 1); the life history of the protoptiline glossosomatid *Culoptila cantha*, which was very common at this site, was studied by Houghton (1997) and will be published in a separate paper. *Protoptila alexanderi* and *Ochrotrichia tarsalis* represented site records not reported by Moulton et al. (1993), as did the following species which did not occur in enough abundance to discern a flight periodicity pattern: *Hydroptila waubesiana* Betten ($n = 63$), *Neotrichia minutisimella* (Chambers) ($n = 1$), *N. vibrans* Ross ($n = 2$), *Oxeythira aculea* Ross ($n = 3$), and *O. azteca* (Mosely) ($n = 2$). *Neotrichia vibrans* also represented a new drainage record.

Protoptila alexanderi Ross. Adults of this species were caught from early July to late September, 1995, and early August to October, 1996 (Fig. 1). Peak abundances occurred in late August, 1995, and early September, 1996, suggesting a synchronized univoltine cycle. Males were slightly more abundant than females; both sexes exhbited similar seasonal periodicity. We collected a series of twelve fifth instar larvae in early July, 1995, on clean 10-20 cm diameter stones in the upstream half of the riffle. Moulton et al. (1993) collected adults from the Paluxy River and Ham Creek, Brazos River tributaries, in June and October. Previously, the species had been reported in Texas only from the San Antonio and San Marcos Rivers (Edwards 1973).

Hydroptila angusta Ross. Adults of this species were collected in all months of the year (Fig. 1) and accounted for 82% of the total hydroptilid sample. As many as four generations may have occurred during both years as suggested by the peaks in abundance, although an exact determination is not possible without extensive larval data. Males and females exhibited similar seasonal periodicity. Larvae were reared to adults during April, July, and September, 1995, and March, April, and June, 1996. Moulton et al. (1993) collected adults throughout their Brazos Drainage study area during the months of March-April,

May-June, and October. Cloud and Stewart (1974a) did not report this species in the drift of the Brazos River. We found substantial numbers of fifth instar larvae in the filamentous algal growth (mostly *Cladophora* sp.) that was common on most of the rocks in the riffle during summer months. When placed on small stones in a petrie dish, larvae were sedentary and held their cases at acute angles to the faces of the stones.

Hydroptila icona Mosely. Adults of this species were collected from early May to November during both years (Fig. 1). Peak abundances of both sexes occurred in late June, 1995, and early July, 1996, suggesting a univoltine cycle; this would corroborate the one-year cycle proposed by Cloud and Stewart (1974a) and Wiggins (1996). However, voltinism is confounded by a second peak in male abundance that occurred in late August, 1995, and early August, 1996. Moulton et al. (1993) collected adults throughout their study area during the months of June and October-November. Cloud and Stewart (1974a) reported *H. icona* as one of the two common hydroptilids at this site and noted a nocturnal drift of both cased and caseless larvae. We did not find larvae of this species in our benthic samples.

Ithytrichia clavata Eaton. Adults of this species were collected from early April to November, 1995, and early April to October, 1996 (Fig. 1). Adult abundance peaked during early May and early September, 1995, and late April and late September, 1996, suggesting a synchronized bivoltine cycle. Males were slightly more abundant during the early generation and females were slightly more abundant in the later generation during both years. A series of 12 pupae collected in early April, 1995, emerged in the laboratory in early May, 1995; a series of 6 pupae collected in early April, 1996, emerged in late April, 1996. We also collected approximately 50 empty cases in early April, 1996, and only one cased larva in early May, 1995. These pupae and empty cases were found on rocks in quiet areas of the riffle. Moulton et al. (1993) collected adults throughout most of their study area, including this site, during the months of March-April, June and October. Despite the low numbers of larvae and pupae that we found, Cloud and Stewart (1974a) reported that *I. clavata* was a common hydroptilid at this site and that it drifted nocturnally. The one fifth instar larva was found on a rock near the head of the riffle. When placed on a small stone in a petrie dish under microscopic light and videotaped, this individual exhibited strong negative phototaxicity and actively sought the underside of the stone. A torsion angle of 90° between the first two abdominal segments, causing the flat sides of the case to be held parallel to the ground, was evident. This phenomenon was also noted for *I. lamellaris* (Nielson 1948).

Ochrotrichia tarsalis (Hagen). Adults of this species were collected from early June to November, 1995, and early April to October, 1996. Adult abun-

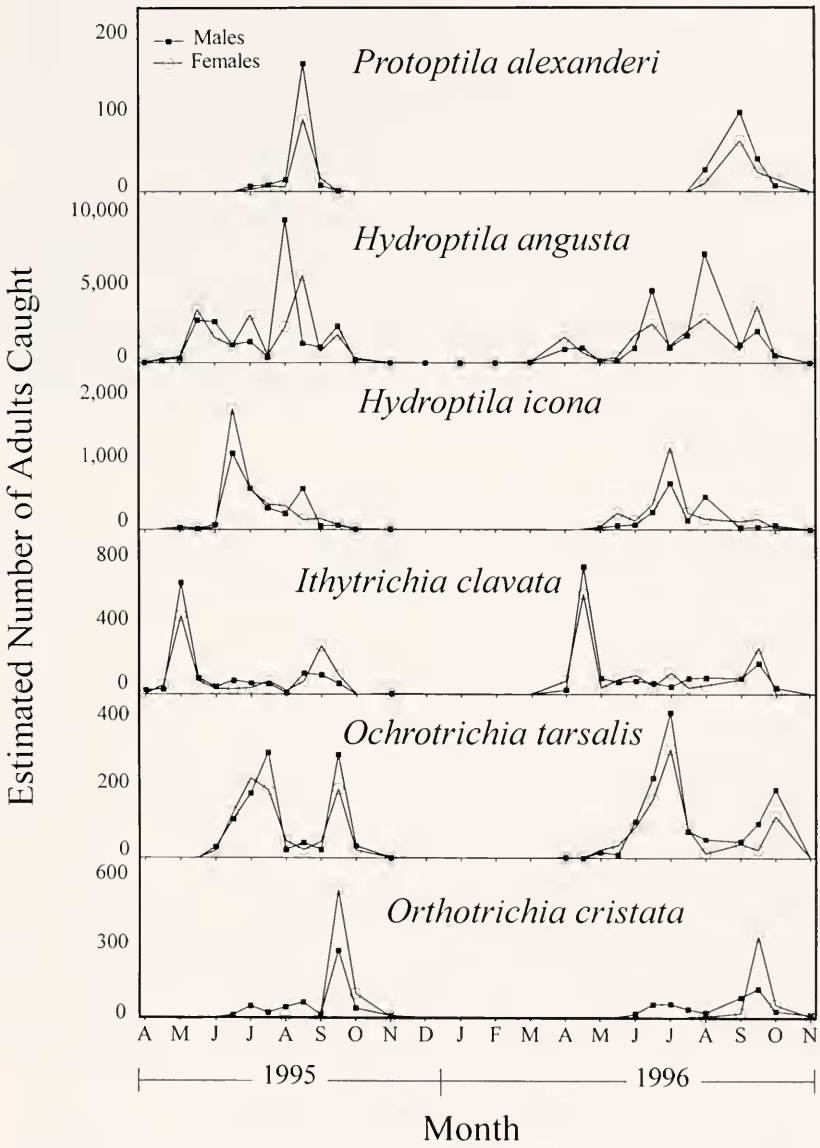

Figure 1. Estimated number of adults caught from a riffle on the Brazos River, Texas from April, 1995, to November, 1996, based on subsamples.

dance peaked in late July and late September, 1995, and early July and October, 1996 (Fig. 1), suggesting a synchronized bivoltine cycle. Males and females had similar seasonal periodicity. Moulton et al. (1993) did not collect this species at our site but found adults in much of their Brazos Drainage study area during June and October. Cloud and Stewart (1974a) reported *Ochrotrichia* larvae in low abundance in their drift samples but did not identify a species. We did not find larvae of this species in our study riffle.

Orthotrichia cristata Morton. Adults of this species were collected from late June to November, 1995, and early June to November, 1996 (Fig. 1). Both sexes peaked in abundance in late September during both years, suggesting a univoltine cycle. However, females were not collected until early August both years, while males were present for 3-4 months before their peak abundance. Moulton et al. (1993) collected adults at our site during June and July. Cloud and Stewart (1974a) report *Orthotrichia* larvae in low abundance in their drift samples but did not identify a species. We did not find larvae of this species in our sampling area.

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